

SUPPLY SYSTEM AND METHOD FOR OPERATION

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of commonly assigned, co-pending U.S.

5 Patent Application Serial No. 09/036,752, which is hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a supply system for the delivery of elements to one or more users comprising a forwarding device (or feeder) which supplies
10 the elements from a stored quantity of the elements to a sorting device, which only permits elements having a predetermined position to pass, and with a transport device, which transports the positionally correctly sorted elements to the user, and to a method of operating a user with an attachable supply system in accordance with the preamble of claim 26.

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DESCRIPTION OF PRIOR ART

[0003] In the sheet metal processing industry stationary or mobile sorting systems and/or transport systems are used for the installation of fastening elements, guide elements or reinforcing elements in sheet metal parts. Mobile units are used as necessary at various
20 points of installation of the elements in a factory.

[0004] These sorting and conveying systems are suitable either for the processing of a single type of element or for geometrically closely related families of elements. They consist as a

rule of a container which receives the elements which are filled into it as a bulk fill, a sorter which brings the elements into a defined transport position and a transport device which produces the feed force for the transport of the elements to the point of installation.

[0005] Known are sorting systems which operate on the basis of vibratory or belt feeders and which sort in-filled elements via features of shape or their center of gravity. For the transport devices one distinguishes between blowing systems and pushing systems. Both vibratory feeders and belt feeders and also the associated blowing and pushing transport devices are available from the company Profil Verbindungstechnik GmbH and Co. KG, Friedrichsdorf, Germany, amongst others, and have been part of their sales program for a long time.

[0006] In a special case, in which the sorter can be so arranged with respect to the point of installation that the elements to be processed can reach the place of installation via slides under the action of gravity, the transport device can be formed as a slide.

[0007] The above-described sorting and transport systems represent a relatively high investment cost, with a restricted spectrum of use because of the direct functional tie to the elements to be processed. An economical use is, as a result, only possible when correspondingly high production quantities and/or long periods of use are present. The sorting and forwarding devices which have hitherto been produced by the company Profil Verbindungstechnik GmbH and Co. KG, have the following basic layout:

[0008] As a rule, the systems are designed as mobile units. In special cases apparatus installed at a fixed location also exists. In both cases the installation of all the components associated with the particular feeding and sorting system takes place on a platform. The

elements which are put into the machine in bulk form are moved towards the sorter either with the aid of a vibratory feeder or with drum or chain link feeders with a scooping action (known as belt feeders). Systems based on vibratory feeders having sorting chicanes which so orient the elements via the position of their center of gravity or specific features of shape that only parts oriented in a specific position can pass via slides to the feed apparatus.

Elements which do not have the desired position, however, fall back into the supply of elements, i.e., into the element supply chamber.

[0009] In contrast systems which are based on belt feeders having sorting chicanes in which the elements have to pass through a chicane corresponding to their outline. Parts which are not correctly oriented position-wise are tipped back into the supply bunker with the aid of a toothed roller or are scraped away, for example, with the aid of a transversely movable comb.

[0010] The apparatus for advancing the elements from the sorter to the user, i.e., the transport devices, are based on pushing or blowing systems with the aid of which the elements to be transported are supplied either element by element (blowing method of transport) or in a chain through flexible plastic hoses (pushing method of transport) to the processing station, i.e., to the user.

[0011] With blowing systems, the elements are supplied with the aid of a pulse of compressed air through a plastic hose to the processing station at the user.

[0012] In contrast, with pushing apparatus, use is made of systems which work with the aid of pneumatic cylinders and systems which are based on the working principle of frictional forces produced by rotating magnetic discs. The control of the entire sorting and feeding

system takes place as a rule through SPS base control cabinets, with the aid of which the interfaces to the operator and optionally to the installation machine can also be monitored. Pneumatic control devices, hydro-pneumatic oiling devices and acoustic and accident protection means complete the functional system.

5 [0013] All the above described pieces of sorting and transport apparatus are so designed that using it only a defined element or a small number of geometrically similar components can be processed.

[0014] A problem with the previously known sorting and transport systems is that the close association with the respective element to be transported and with the machine which processes this element, i.e., the user, means that the particular sorting and transport systems are not frequently used, other than in mass production, but must however be available in case the same sheet metal part is to be manufactured again. In other words, the previously known sorting and transport systems represent relatively complicated pieces of apparatus which are however used relatively seldom.

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OBJECT OF THE INVENTION

[0015] It is the object of the present invention to provide a supply system of the initially named kind which can be flexibly used, even with the need to handle different elements or different connection elements, with it being possible to lower the investment costs and to achieve higher flexibility and a higher use factor.

BRIEF DESCRIPTION OF THE INVENTION

[0016] In order to satisfy this object there is provided a supply system for the delivery of elements to one or more users comprising a forwarding device (or feeder) which supplies the elements from a stored quantity of the elements to a sorting device, which only permits
5 elements having a predetermined position to pass and with a transport device, which transports the positionally correctly sorted elements to the user. In other words, the forwarding device or feeder which feeds and controls the sorting device forms a part of a basic module, whereas the sorting device and the transport device belong to an interchangeable module.

[0017] In other words, through a modular design, a basic system is achieved which can be used independently of the particular element and which can, if required, be combined with rapidly interchangeable modules which have to be designed in dependence on the elements.

This signifies that the basic module is designed for the handling of a plurality of different elements and can thus be used for a spectrum of different elements. In this connection the

15 elements can be filled true-to-type into respective supply chambers of the basic module, or a mixture can be present in one supply chamber or a plurality of supply chambers of the basic module. Should the basic module be used for the feeding of a plurality of like processing stations at the user or at a plurality of users, i.e., should only one type of element be used, then these elements can either be filled into the (single) supply chamber of the basic module
20 or into the supply chambers of the basic module, depending on how the basic module is designed.

[0018] The forwarding device which feeds the sorting device can either be designed for the forwarding of elements from all the supply chambers of the basic module simultaneously, or as respective forwarding units for each supply chamber individually. Since a situation relatively frequently arises in practice in which the supply system has to feed a plurality of different working stations at one or more users, with different elements being used for the differing working stations, it is possible for the basic module to have a plurality of supply chambers for the different elements. Depending on the design of the basic module from one to six supply chambers can be present, but other numbers of chambers are also entirely conceivable. In this way the danger of mixing can be precluded, i.e., an element of a specific kind or size cannot enter into a neighboring forwarding path for another element, i.e., of a different kind or size.

[0019] The sorting device can comprise one sorting unit for the feeding of a single working station of the user or can comprise a plurality of like or different sorting units, whereby the simultaneous feeding of a corresponding number of working stations with like or different elements is possible. Even though the sorting units are each designed for a specific element, and can thus differ from one another, as a result of their design for use with different elements with different manners of transport (for example, pushing or blowing), they can, nevertheless, have certain basic dimensions in common, whereby they can, so to say, be arranged alongside one another in accordance with a grid dimension and economically secured to the basic module.

[0020] There are several possibilities of coupling the interchangeable modules to the basic module.

[0021] On the other hand, a transport carriage can be provided for the interchangeable module in accordance with Claim 19, with this transport carriage optionally having space for one interchangeable module or for a plurality of interchangeable modules.

[0022] In accordance with Claim 20, both the platform of the basic module and also the platform of the transport carriage can have a respective rail means, whereby an interchangeable module located on the rail means of the basic module can be pushed onto the rail means of the transport carriage, and an interchangeable module located on the rail means of the transport carriage can be pushed onto the rail means of the basic module. In this respect, a latching means is preferably provided in order to non-displaceably latch the interchangeable module located on the rail means of the basic module to the basic module.

[0023] The transport carriage is then preferably designed in accordance with Claim 21 to receive at least two interchangeable modules, which each have space on the rail means. The rail means is either located on a rotary table of the transport carriage or the transport carriage can be aligned with the basic module at two positions displaced by 180° by means of corresponding wheels.

[0024] In accordance with Claim 22, a lifting device can also be used for the exchange of the exchangeable module, or the transport carriage of the exchangeable module can be docked at a docking position at the basic module or can be moved into a receiving bay in the basic module. The transport carriage for the interchangeable module can remain at least substantially always together with the latter and can, when required, also be exploited for the coupling of the interchangeable module to the basic module. For example, the transport

carriage can have extendible and retractable wheels which can be used to lift the interchangeable module and to lower the same onto the basic module.

[0025] In one possible embodiment, the basic module is formed as a mobile unit, which can be shifted with or without the respective exchangeable module to be installed thereon into the vicinity of any desired users, so that not only the interchangeable modules but rather also the basic module can be selectively used at different locations of use.

[0026] Since the basic module includes all the components and modules which are universally usable for different elements, such as for example the installation platform of the basic module, the electrical control cabinet, which includes various functions, the pneumatic module, an oiling system, acoustic and accident protection means, chain conveyors and the element supply chamber or chambers, one succeeds in utilizing the basic module more frequently and the total number of the modules of this kind present in a factory can be substantially reduced, whereby the economics improve. Since the basic module is element-independent, the storage of spare parts and servicing can be made simpler.

[0027] Since the element-specific modules (sorter device and transport device) can be rapidly changed, the economics of the solution of the invention are further improved.

[0028] The possibility of fully emptying the element supply chamber or bunker aimed at in accordance with the invention likewise enables a rapid changeover of the basic module for the processing of different elements.

[0029] Moreover, an automatic adaptation of the control functions of the electrical control cabinet to the manner of operation of the respectively installed transport device and also the storage of the machine parameters which are to be set during the installation procedure are

preferably realized. In accordance with the invention, an automatic adaptation of this kind can also take place for the pneumatic supply.

[0030] Although the present invention is primarily intended for use with fastener elements and automatic machines, such as presses for the processing of the elements, it can also be used in other areas.

[0031] Ultimately, all parts which are delivered in bulk and which can be conveyed individually, for example mechanical components which are to be installed by an automatic machine to form a mechanism, or buttons which have to be delivered to different automatic sewing machines, can ultimately be considered as elements.

[0032] Further preferred embodiments of the invention can be found from the subordinate claims and also from the subsequent description.

BRIEF LISTING OF THE FIGURES

[0015] The invention will be described in the following in more detail with reference to the drawings, which show:

[0016] Fig. 1 a schematic illustration of a modular supply system in accordance with the invention at a press,

[0017] Fig. 2 a partly sectioned illustration of the apparatus of Fig. 1 as seen at the section plane II-II in Fig. 1,

[0018] Fig. 3 a side view of a modularly built up supply system in accordance with the invention directly prior to the exchange of the exchangeable module,

[0019] Fig. 4 a plan view of the apparatus of Fig. 3,

[0020] Fig. 5 a representation similar to Fig. 3, but in a first stage of the exchange of the module,

[0021] Fig. 6 a plan view of the supply system of Fig. 5, but at a somewhat later point in time,

5 [0022] Fig. 7 a representation similar to Fig. 5, but at a later stage of the exchange of the module,

[0023] Fig. 8 a plan view of the supply system of Fig. 7 but here also at a later point in time,

[0024] Fig. 9 a representation similar to Fig. 3, but in the last stage of the exchange of the
10 module,

[0025] Fig. 10a plan view of the supply system in accordance with Fig. 9,

[0026] Fig. 11a side view of a variant of the modular supply system in accordance with the invention shortly before exchange of the module is carried out,

[0027] Fig. 12a plan view of the supply system in accordance with Fig. 11,

15 [0028] Fig. 13a representation in accordance with Fig. 11, but at a later point in time during the exchange of the module,

[0029] Fig. 14a plan view of the supply system of Fig. 13,

[0030] Fig. 15a representation in accordance with Fig. 11, but after carrying out the exchange of the module,

20 [0031] Fig. 16a plan view of the supply system of Fig. 15,

[0032] Fig. 17a side view of a further variant of a modular supply system in accordance with the invention,

[0033] Fig. 18a plan view of the supply system of Fig. 17,

[0034] Fig. 19a representation in accordance with Fig. 17, but in the first stage of a module change,

[0035] Fig. 20a plan view of the supply system of Fig. 19,

5 [0036] Fig. 21a representation corresponding to the Fig. 19, but at a later point in time of the module change,

[0037] Fig. 22a plan view of the supply system in accordance with Fig. 21,

[0038] Fig. 23a representation in accordance with Fig. 21, but after separation of the exchangeable module from the basic module,

10 [0039] Fig. 24a plan view of the supply system in accordance with Fig. 23,

[0040] Fig. 25a side view similar to Fig. 3, but with a further modular supply system in accordance with the invention

[0041] Fig. 26a plan view of the supply system of Fig. 25,

15 [0042] Fig. 27a side view in accordance with Fig. 3 of a further variant of a modular supply system in accordance with the invention

[0043] Fig. 28a plan view of the supply system of Fig. 27,

[0044] Fig. 29a partly sectioned side representation of a modular transport device in a pushing embodiment,

[0045] Fig. 30a cross-section corresponding to the section plane XXX-XXX of Fig. 29,

20 [0046] Fig. 31a cross-section through a modular transport unit in a blowing embodiment prior to the coupling on of the transport line,

[0047] Fig. 32a representation in accordance with Fig. 31, but after coupling on of the transport line an directly before blowing,

[0048] Fig. 33a section representation in accordance with the section plane XXXIII-XXXIII of Fig. 31 to the left hand side of the central axis in Fig. 33, while the right hand half shows a corresponding sectional drawing from the stage of Fig. 32, in both cases after the transport line has been coupled on,

[0049] Fig. 34a plan view on the embodiment of Fig. 31, as seen in the direction of the arrow XXXIV,

[0050] Fig. 35 an alternative transport unit in a magnetic embodiment,

[0051] Fig. 36 a representation similar to Fig. 7, incorporating a turntable,

[0052] Fig. 37 a plan view of the supply system in accordance with Fig. 36.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Figs. 1 and 2 show, first of all, a schematic representation of the supply system 10 in accordance with the invention, which is designed here for the delivery of connection elements (not shown) to a user in the form of a press, wherein the non-illustrated elements are guided via lines 14 to a tool 16 located in the working region of the press. The lines 14 can, for example, be realized in the form of supply hoses, forwarding rails or guide rails for elements.

[0016] In this specific example, four lines 14 are provided, which start from four transport units 18 arranged alongside one another in the supply system and lead to respective setting heads 20 within the press, with the four setting heads 20 in this example being associated

with the upper tool 16 of the press 12. The lines 14 are flexible plastic hoses, so that the positioning of the supply system with respect to the press is not critical. The supply system 10 can, for example, be arranged in the broken-line position 10' in Fig. 2, whereby the lines 14', which are correspondingly shown in broken lines, lead via gentle 90° arcs to the individual setting heads 20. The reference numeral 14" indicates the possibility of selectively guiding the lines to the rear side of the press to two further setting heads 20" in the upper tool 16. If the two lines 14" are simultaneously used with the four lines 14 and 14' respectively, then two further transport units (18) not shown must be present in the supply system 10.

[0017] Fig. 1 shows that the lines 14" can be guided in different manners to the rear side of the press, with the example in Fig. 1 showing two alternative possibilities for the lines 14", namely passing laterally past the press – as also shown in Fig. 2 – or however passing over the top side of the press. In both cases suitable holders 22 are provided. The reference numeral 24 indicates connectors which can be used to connect the lines if an extension beyond the basic length is necessary.

[0018] The representation of Figs. 1 and 2 merely give example for the paths of the lines 14. They are in no way to be regarded as restrictive. Both the number of the respective lines and also the paths, arrangement, suspension, and support of the individual lines can in principle be selected as desired. The setting heads 20 need also not be arranged on the upper tool of the press, they can also be arranged on the lower tool of the press or also on a tool arranged on an intermediate plate.

[0019] The supply of the elements from the supply system to the press must harmonize with the working cycle of the press. For this purposes electrical lines 26 and also pneumatic lines 28 and optionally also hydraulic lines 30 extend between the press and the supply system.

5 [0020] It can, moreover, be found from Fig. 1 that the supply system includes an installation platform 34, which is movable on wheels 32. In this manner the supply system can easily be displaced to different positions within a factory. The wheels can optionally be equipped with brakes in order to hold them in a selected operating position relative to the press. Other stopping possibilities can also be considered, for example direct screwing or
10 anchoring of the platform 34 to the floor 36 of the factory room.

[0021] It is not absolutely essential that the platform 34 has wheels. It could, for example, also be executed as a pallet, so that a displacement is possible at any time, for example by means of a low lift platform truck or a forklift truck.

[0022] The reference numeral 38 indicates a display and switching panel, which can be used
15 by the operator.

[0023] The layout of a first embodiment of the modular supply system of the invention will be explained in the following in more detail with reference to Figs. 3 and 10, with these drawings also serving to explain the exchange of the exchangeable module.

[0024] Referring to Figs. 3 and 4, the basic module 10 of Fig. 1 can first be seen, which is
20 however turned through 180° here relative to the embodiment in Fig. 1, and also uses a differently designed forwarding device or feeder.

[0025] In these figures and also in all subsequent figures the same reference numerals will be used for the same components and also components with the same function. It will be understood that the whole description applies in the same way for all parts with the reference numerals, and indeed even then when these parts are provided with a dash at the top or a double dash at the top, i.e., for the sake of economy a repeated description of the same parts or parts with the same function in the different embodiments will be dispensed with.

[0026] The modular supply system 10, i.e., the modular supply apparatus 10 of Fig. 3, is also formed here as a mobile unit with wheels 32, with the wheels also being attached here to the platform 34. This platform 34 belongs to the so-called basic module 40. In the illustration of Fig. 3, an exchangeable module 42 is located in the mobile unit 10 in addition to the basic module 40, and is installed on the platform 34 of the basic module 40. Stated more precisely, the installation platform 34 is equipped with rails 44, on which the interchangeable module 42 is linearly displaceable but can be registered in the working position by pins (not shown) and latched mechanically via a quick acting closure 46 to the basic module 40 in the desired position on the rails 44.

[0027] At the left of the mobile unit 10 there is located a second exchangeable module 42' which is arranged on rails 48 corresponding in their design to the rails 44. The rails 48 are in turn mounted on a transport carriage 50, with the transport carriage in this embodiment likewise being equipped with wheels 52 and corresponding brake devices 54.

[0028] At the side of the transport carriage 50 facing the mobile unit 10 there is located a centering device 56, which, on the movement of the transport carriage 50 up to the docking position at the mobile unit 10, is received in a corresponding recess in the mobile platform

34 and can optionally be latched to this mobile platform by a latch bolt or the like. In this docking position, optionally with latching, the rails 48 are aligned with the rails 44 and merge directly into one another, for example as is shown by Fig. 6.

[0029] Prior to the movement of the transport carriage up to the docking position of the basic module the exchangeable module 42' is first shifted, after releasing the latch 58, from the middle transport position in accordance with Fig. 3, to the left on the transport carriage 50 in order to provide space at the right hand side of the transport carriage 50 for the reception of the module 42 to be exchanged.

[0030] Fig. 6 shows the transport carriage docked at the docking position directly prior to the exchange of the exchangeable module 42. Prior to the exchange of this module, a multi-plug 60 for the pneumatic system and a multi-plug 62 for the electrical system have to be separated from the exchangeable module 42. After the release of the mechanical quick acting closure 46, the exchangeable module 42 can be shifted in the direction of the arrow 64 to the left, onto the right side of the transport carriage 50, with the aligned rails 48 and 44 serving for this purpose.

[0031] After the module 42 to be exchanged and the module 42' to be newly inserted into the mobile unit are both present on the transport carriage 50, the coupling 56 of the transport carriage to the mobile unit 10 is released. The released state is shown in turn in Fig. 7.

[0032] The transport carriage can now be laterally (as illustrated by arrow 66 in Fig. 8) translated to the left as shown in Fig. 7 and away from the mobile unit 10. The carriage is then turned around end for end (as illustrated by arrow 68 in Fig. 8) so that module 42' is most proximate to the mobile unit 10. The carriage is again laterally moved to the right

(as illustrated by arrow 66 in Fig. 8) towards the mobile unit 10. After this movement the exchanged module 42 is located at the left hand side of the transport carriage 50 in Fig. 8 while the exchangeable module 42' is now present directly in front of the mobile unit 10.

The transport carriage 50 is now moved again to the docking position at the mobile unit 10 and the exchangeable module 42' is pushed, optionally after latching the transport carriage 50 to the mobile unit 10, from the rails 48 onto the aligned rails 44 of the mobile unit until it strikes the registration pins (not shown) and a mechanical quick acting latching device 46 snaps into place for the mechanical latching of the newly exchanged module 42' or is engaged in order to non-displaceably couple the exchanged module 42' to the mobile unit 10. The multi-plug 60 for the pneumatic system and the multi-plug 62 for the electronic system can now be coupled to the newly exchanged module 42'. After the removal of the transport carriage to the left and after shifting of the exchangeable module 42 into the center of the transport carriage, the situation of Fig. 3 has again been produced.

[0033] Instead of turning the transport carriage 50 around in accordance with the arrow 68, it is entirely conceivable to install the rails 48 of the transport carriage 50 on a rotary table 50, which should then be rotatably arranged about a vertical axis of rotation 59 arranged approximately at the center of the transport carriage 50 as shown in Figs. 36 & 37, so that only a small separation of the transport carriage from the mobile unit is necessary in order to rotate the rotary table, which is likewise schematically represented by the arrow 68. The separation of the transport carriage from the mobile unit must only

be sufficient in order to ensure the rotatability of the rotary table, without the modules striking the mobile unit.

[0034] In the representation of Figs. 3 to 10, the exchangeable module 42 and also the exchangeable module 42' consist of four like sorting devices 70 and 70' arranged alongside one another, which are coupled to the respective transport device 72 and 72' respectively and supply elements sorted in accordance with the features or shapes and/or the position of the center of gravity of the respective transport units 72 and 72' respectively.

[0035] The four like sorting devices 70 and 70' and the corresponding transport devices 72 and 72' are in each case formed as a unit, i.e., a module, so that the exchangeable module is itself of modular design and can be rapidly assembled from individual sorting and transport units 70 and 72 by connecting together the desired number of units depending on how many such units are to be present in the exchangeable module. For this reason, the sorting devices 70 and 70' and transport devices 72 and 72' will frequently be referred to in the following as "units". It will be understood that the devices and the units are one and the same thing, and the term unit is merely meant to emphasize the modular design of the respective devices.

[0036] The precise design of the respective sorting units 70 and 70' and of the transport units 72 and 72' respectively is not of particular importance. These components can be designed in accordance with the previously known components used for the same purposes, e.g., as sold by the present applicants, provided that they are designed in such a way that they can be arranged in space-saving manner alongside one another in a multiple-arrangement, as with the four respective units, which are shown in Figs. 3 to 10. For the

sake of completeness, examples of transport units operating with blowing and pushing will be described later with respect to Figs. 25 to 35.

[0037] Although in the Figs. 3 to 10 four like sorting devices, 70 and 70' respectively, and four like transport devices, 72 and 72' respectively, are shown, so that one could assume that they can be used for four identical or similar elements in different sizes, the modularity of the present invention is so selected that in the embodiment shown here the four sorting and transport devices can be selected at will in order to dispense up to four elements from a total spectrum of elements of different types and sizes to the respective user.

[0038] By way of example, a quadruple arrangement is shown in the illustration of Fig. 26, with two tracks for the pushing feeding of nuts through the transport devices 72 as previously described and two tracks for the blowing transport of bolts by means of blowing transport devices 72". That is to say, a total of four transport devices 72 and 72", which are likewise of modular design, are arranged in four tracks alongside one another.

[0039] Expression should also be given to the fact that the invention is not restricted to the use of four tracks or transport devices. In principle, any desired number of tracks can be provided. An apparatus can also be equipped with only one to three transport devices or with more than four transport devices. The modular concept make sit possible to equip the mobile platform 50 of the interchangeable module 42 and 42' as desired with sorting and transport devices 70, 70' and 72, 72', 72" of different modular designs.

[0040] In the Figs. 3 to 10 one can see, moreover, the connections 74, 74' for the lines 14, 14' and 14" respectively of Figs. 1 and 2. These lines are normally coupled, in accordance

with the invention, via quick acting couplings, to the respective connections 74 and 74', which is naturally a precondition for the supply of the respective elements to the user.

[0041] The basic module 40 of Fig. 3 includes a forwarding device or feeder 76 which serves for the forwarding of the elements from a supply chamber 78 to the sorting device

70. Various possibilities exist of the design of this forwarding device.

[0042] If the same elements are delivered to all the sorting and transport devices, then one can operate with a forwarding device 76 – shown in Figs. 3 to 10 as a chain conveyor – which lifts the elements out of the supply bunker 78, using plates 76' connected to the chain 76" of the chain conveyor, and feeds them to the sorting chicanes associated with the sorting devices, from where all the elements which are not aligned in the transport position drop back via the slide 79 into the supply bunker. The feeding of the elements to the sorting units 70 can simply consist of the belt feeder or chain conveyor lifting the elements from the supply chamber 78 and dropping them onto the sorting units 70.

[0043] It can, for example, also be seen from Fig. 3 that the elements can be filled into the supply bunker 78 via filling flap hinged at 84 and a slide 82, for which it is necessary to first open the flap 80.

[0044] In the lower inclined wall 86 of the supply bunker 78, there is likewise located a flap 88, which can be pivoted outwardly into the position 88' in order to fully empty the supply bunker 78. During this the elements still located in the supply bunker 78 fall into a box 90 arranged beneath the mobile platform 34. When the flap 80 is open, it is possible to check that the supply bunker 78 has been fully emptied. This would normally be done when a module change of the exchangeable module 42 is carried out, because the module 42 to be

exchanged is normally only exchanged when the user is to be equipped for use with other elements or other element sizes or with a different complement of elements.

[0045] In the most preferred embodiment, only one supply chamber or bunker 78 is provided and is filled with just one type and size of element. In this way there is no danger

5 of different type and sizes of elements being confused either by the sorting units 70 in use or by the operator when refilling the supply chamber 78. The modular design is of importance in such a case. First of all, any number of units 70, 72 for the sorting and transport of the elements can be used up to the maximum number permitted by the design of the basic module 40. Secondly, it is readily possible to convert the system to use different numbers
10 of units 70, 72 for the sorting and transport of the elements. Thirdly, sorting and transport units 70' and 72' not in use with the one basic module 40 can be used with another basic module 40 rather than simply lying idle, as would be the case if a prior art purpose design system was used at less than its fully capacity. Fourthly, the conversion from one type and

size of one element to another can also be effected quickly. It is simply necessary to remove
15 all unused elements from the supply chamber and to replace them with a new type or size of element and to exchange the sorting and transport units 70, 72 previously used for new ones 70', 72', which can be used with the new type and size of element. In addition, the components belonging to the basic module 40 are used more cost-effectively. In the absence
20 of the modular system of the invention, these components would all have to be present twice, once for the sorting and transport system 70, 72 in use, and once for the sorting and transport system 70', 72', of which use has been temporarily discontinued. Moreover, the

conversion from one type and size of element to another can take place very quickly and storage space is minimized.

[0046] The sorting and transport units 70', 72' can all be rapidly connected together by any convenient means and exchanged as a whole. The basic module 40 simply has an opening for receiving the sorting units 70, 70' of the sorting and transport units 70, 72'. Baffle elements or plates present on the sorting units and within the basic module prevent elements from escaping from the basic module and ensure that, if they are not passed on by the sorting units, they fall back into the supply chamber 78.

[0047] If fewer than the maximum number of sorting and transport units 70, 72 are used, then any remaining part of the receiving opening in the basic module not already covered over by the units 70, 72 in use can be simply covered over by a plate mounted on the exchangeable module or by a plate mounted on the basic module, and of course the design of such a blanking plate can be chosen so that it can be removed and fitted extremely quickly.

[0048] It will be noted that the connection between the exchangeable module 42, 42' and the basic module 40 conveniently takes place at the base plate 34 of the basic module 40 so that no physical connection is necessary at the periphery of the receiving opening of the basic module 40. However, such a physical connection would also be possible if desired. Moreover, if desired, guide means could be provided at or close to the receiving opening to ensure adequate guidance of the sorting units 70, 70' when inserted into the receiving opening.

[0049] The above-described advantages also generally apply to the other variants of the supply system of the invention described herein.

[0050] The toothed rollers and transversely moveable combs of the sorting units and the chain or belt of the belt feeder are usually driven by respective electric motors. The use of combs and rollers in sorting systems are well known in the art and are widely used in prior art sorting apparatuses, and those practiced in the art will appreciate their design and function without further description herein. The connection to the electric motors for the toothed rollers and transversely moveable combs of the sorting units are effected via the electrical multi-plug 62. The drive connection to the motor of the belt feeder 76 forms part of the basic module.

[0051] It is likewise possible to operate solely with one supply bunker when different elements are to be processed. In this case the different elements are put into the supply bunker 78 as a mixture and the sorting takes place automatically via the respective tracks, i.e., via the respective sorting devices 70, 70' associated with the respective transport devices 72, 72', 72".

[0052] Another possibility lies in providing the supply chamber 78 with a number of supply chambers (not shown), which corresponds to the number of the sorting units and tracks that are provided. The chain conveyor 76 is laid out using partition webs so that only elements from the respective supply chambers can be fed to the respective sorting devices without passing undesirably into neighboring supply chambers. With this arrangement, sorting also takes place through the sorting devices, but here in such a way that only elements which have the correct transport position are passed on further to the

transport devices. Should an element, despite this subdivision into supply chambers, not pass in the desired correct transport position to the respectively associated sorting device, then it is nevertheless rejected by the sorting device, assuming that the sorting devices are so designed that they only allow elements to pass which have the correct shape, size and transport position. If separate supply chambers are provided, then the sorting devices are preferably so designed that elements which are not let through, for example because they are not correctly positioned, drop back into the respectively provided supply chambers in order to avoid an undesired mixing of the elements.

[0053] In an arrangement with a plurality of supply chambers it is also advantageous when all the supply chambers can be simultaneously emptied, for example through a flap 88, which is provided in common for all supply chambers, but which has perpendicular webs which prevent mixing of the emptied elements.

[0054] At this point expression should also be given to the fact that the forwarding device does not necessarily have to be designed as a chain conveyor. There are certainly other possibilities, for example the possibility of designing this device as a so-called vibratory feeder 76' as shown in the embodiments of Figs. 27 and 28, or one can also operate with an inclined rotatable drum 76", a drum feeder, as shown in the embodiment of Figs. 1 and 2, with it being necessary, with this embodiment, to operate with a mixture of elements, unless all the attached tracks are provided for the processing of the same element. In this case the drum conveyor 76" again contains elements of just one type (i.e. and size).

[0055] The mobile unit 10 includes, as part of basic module 40, universally useable components including an electrical control cabinet with display 38, a pneumatic module

96, an oiling system 98 and also noise and accident protection devices known in the art. The electrical control cabinet 38 includes a number of devices, not separately shown but nonetheless important for the universal applicability of the basic module 40. These universal components are in each case known per se in customary supply systems and are here simply so combined by corresponding interfaces, for example connected to the programming, that they can be used for all the exchangeable modules 42, 42', 42", connectable to the basic module 40. The universal components of the control cabinet include the following:

- a) mains connection,
- b) input and output units,
- c) programmable control for the control or regulation of operating parameters, such as for example switching on and off of the forwarding device 76, 76', 76", controlling or regulating the working speed of the forwarding device 76, 76', 76", regulating the pressure of the transport device 72, 72', 72", and regulating the supply pressure of setting heads 20, 20" connected to the transport devices 72, 72', 72", i.e., to the lines 14, 14', and the pressure of the oiling device 98,

- d) a recognition device for the recognition of the functional component groups 70, 70', 72, 72', 72", which are present at the interchangeable module 42, 42', 42" and connected to the basic module 40,

- e) connections for signals from sensors on the basic module 40, the interchangeable module 42, 42', 42" or user 12, such as for example filling state measuring

sensors on the basic module 40, and end switches, end position sensors at the transport device 72, 72', 72" and in the setting head 20, 20' and, if required,

f) one or more connection lines 26, 28, 30 for the signal transmission between the supply system 10 and the user 12 and/or from the user 12 to the supply system 10.

[0056] Moreover, the supply system, i.e., the basic module, has the pneumatic supply 96, which can, for example, include a filter, an oiler (including an oil tank), a water separator, valves, power units and also one or more connection devices, and optionally a compressor unit, with the coupling of the pneumatic supply to the exchangeable module 42, 42' or 42" preferably taking place via the multi-plug 60.

[0057] First of all, it is pointed out that although compressed air is available in most factories, situations can certainly arise in which the performance of the factory internal pneumatic supply system is almost at the limit of its capability, or in which pressure fluctuations have to be feared which cannot be reconciled with the operation of the supply system of the invention. In order to guard against such cases it can be sensible to equip the supply system with its own compressor unit, which then belongs to the basic module. Otherwise, if an adequate factory internal supply system is present, then the required compressed air can be taken from this system.

[0058] Depending on how the transport devices 72, 72', 72" are designed and which element types and sizes are to be processed, a respective compressed air requirement is determined for each transport device, which can, amongst other things, also depend on the length of the respective line 14, 14', 14" respectively. The once found values for the

operating parameters for specific configurations, such as values for the air pressure and the rate of oil feed, are, for example, fed into a microprocessor or into a memory in the control cabinet via an input unit, or the respectively attached exchangeable module and also the sorting and/or transport devices associated with it, are recognized by the system itself on the connection of different exchangeable modules, whereby the desired controls can automatically be effected in accordance with the previously programmed or stored values.

[0059] The multi-plug 60 for the pneumatic system is preferably so designed that the pneumatic supply can recognize which tasks it has to satisfy for the respectively connected exchangeable module. Here also one can turn to the corresponding previously fixed pressure values and flow quantities. All these measures ensure that with a module change, a quick and economical adaptation to the various circumstances of the inserted, exchangeable module 42, 42', 42" takes place.

[0060] The basic module 40 also includes the oiling device 98, which can either be supplied from the pneumatic supply 96 or separately. The point of this oiling device is to provide the individual elements or a number of them with a small quantity of lubricant so that, on the one hand, they slide without problem through the supply system to the user and, on the other hand, to ensure, if required, improved frictional conditions at the user by the transmission of lubricant. The oiling system can also differ in a manner specific to the element or to the application, depending on the requirements.

[0061] The basic module, however, also includes a noise and safety protection means. The noise protection consists, above all, of an insulation (not shown), which is provided in the region of the supply bunker 78, of the forwarding device 76 and of the surrounding housing

and sheet metal parts, for example also at the flap 80 and at the flap 88. In this way operating noises are damped so that the noise level of the supply system can be kept within acceptable limits. Acoustic insulation around the transport devices can, if necessary, also be provided because these also produce operating noises.

5 [0062] Contacts which prevent the supply system being taken into operation when the flap 80 or the flap 88' are opened, or with faulty connections of the exchangeable module, or light barriers which prevent operation when an operator or an unauthorized person reaches into areas of the supply system, belong to the important safety devices. Such safety devices should also serve to interrupt the operation of the supply system when, during operation, a
10 flap is opened in unauthorized manner, or someone interferes in dangerous regions of the supply system.

[0063] The invention will now be explained in more detail with reference to further embodiments.

[0064] Figs. 11 to 16 show an alternative way of effecting a change of the exchangeable
15 module. For this purpose a separate transport carriage 50 is provided for each exchangeable module. Fig. 11 shows a situation in which the basic module 40 is available to receive an exchangeable module 42. The exchangeable module 42 is located on the respective transport carriage 50. In this embodiment rails are avoided. In place of this, the mounting platform 34 is equipped with conical centering spigots 35 or other guide means (Fig. 12),
20 onto which the exchangeable module 42', which has been transported into place is lowered from above by means of a lifting device 100. A conical bore 45 is machined into the base plate 52 for the exchangeable module for each centering spigot 35, so that a form-locked

latching prevents horizontal slippage of the module. A central mounting screw 46 prevents a movement in the vertical direction. In the Figs. 11 and 12 the transport carriage 50 is moved into the direct vicinity of the basic module 40, i.e., of the mobile unit 10. The Figs. 13 and 14 show the lifting (arrow 110) and the horizontal transport (arrow 112) of the lifted exchangeable module 42', which is subsequently lowered in accordance with the arrow 114 onto the centering spigots 35 at the mobile platform 34 of the mobile unit 10, i.e., of the basic module 40. The emptied transport carriage 50 can then be removed from the working range of the supply system.

[0065] In this embodiment it is not necessary to latch the transport carriage 50 to the mobile platform 34. It is sufficient to actuate the braking devices 54 of the transport carriage 50 and 33 of the mobile platform 34.

[0066] Figs. 15 and 16 show the position after the lowering of the exchangeable module 42' onto the platform 34 of the mobile unit, and after the insertion of the multiple pneumatic plug 60 and of the multiple electrical plug 62.

[0067] The Figs. 17 to 24 show a third variant, in which the mounting platform 34 is provided with a rectangular cutout or receiving bay 112, into which the exchangeable module mounted on a separate transport carriage 50 is pushed. The chassis 53 of the separate transport carriage 50 is provided with a retractable and extendible platform 51 (see Figs. 18, 20), so that the latter can be lowered from an elevated transport position to the level of the mounting platform 34 of the basic module 40. In this arrangement a horizontal fixing is effected, as in the embodiment of Figs. 11 to 16, i.e., preferably via conical

centering spigots 35 and bores 45, and the securing in the vertical direction can also take place here via an attachment screw 46 or via a quick acting closure.

[0068] The lifting and lowering of the platform 51 of the exchangeable module can take place herein in different ways and means. In the illustrated arrangement the platform 51 is connected via scissors links 104 with the chassis 53 of the transport carriage 50, so that on actuation of the scissors links, for example by means of a spindle, the limbs of the scissors links can adopt different angles to one another, whereby different heights of the platform 51 can be achieved, in similar manner to a scissors type jack.

[0069] Alternatively, the wheels themselves can be adjusted in position relative to the chassis 53, which is, however, not shown here.

[0070] In this embodiment the exchangeable module remains with the transport carriage 50, so that a relatively simple design of the transport carriage is possible, despite the existing possibility of lifting and lowering the platform 51. It is also conceivable to modify the embodiment of Figs. 17 to 24 in such a way that no lifting or lowering of the exchangeable module is effected, but rather only a mechanical latching of the transport carriage with the mobile platform 34 of the basic module 40 after it has been moved into the receiving bay 112.

[0071] The functional sequence in this embodiment is as follows:

[0072] As shown in Figs. 17 and 18, the transport carriage 50 with the sorting and transport devices 70 and 72 to be exchanged, is located in the position on the basic module 40 defined by the centering pins 35. In addition, the transport carriage 50 is secured by means of the screw connection or the quick clamping device 46.

[0073] In the Figs. 19 and 20, the transport carriage 50 is raised after releasing the screw connection or the quick clamping device by railing of the platform 51, until the transport carriage is no longer fixed via the centering spigots 35.

[0074] As shown in Figs. 21 and 22, the transport carriage can now be moved out of the basic module.

[0075] The Figs. 23 and 24 show that the transport carriage with the last used sorting and transport devices is separated from the basic module and is being replaced by another transport carriage 50, with the sorting and transport devices which are to be used next.

[0076] As already indicated previously, the Figs. 25 and 26 show a variant of the modular supply system having here two tracks for the blowing feeding of bolt elements and two tracks for the pushing feeding of nut elements. The connection to the basic module 40 also preferably takes place here via a multi-plug 62 for the pneumatic system and via a multi-plug 62 for the electrical system. The design of the transport device 72 for the pushing feeding is shown in Figs. 29 and 30, while the transport device 72" for the blowing embodiment is shown in the Figs. 31 to 34.

[0077] The Figs. 27 and 28 show that the exchangeable module, even when the basic module is designed to supply four lines 14 or tracks, can be equipped with a smaller number of transport devices, in this case with two tracks for the blowing feeding of bolts by means of two transport devices 72", which correspond to the transport devices 72" of Fig. 26.

[0078] Another difference in the embodiment of Figs. 27 and 28 is the use of a different forwarding device 76, here for example of a vibratory feeder 76' for the delivery of the elements to the sorting device 70 associated with the transport devices. Such vibratory

feeders are known per se and are available from the company Profil. They are therefore not specially described here.

[0079] In the embodiment of Figs. 25 and 26 or 27 and 28, the precise nature of the hand-over of the exchangeable module to the basic module is not shown. This can, however, take place as desired, for example in accordance with one of the previously described variants, with the use of centering spigots 35 being shown here in accordance with the embodiment of Figs. 11 to 16, i.e., a lifting device 110 comes into use here.

[0080] In the transport device for the pushing feeding of the nut elements in accordance with Figs. 29 and 30, two tracks 120, 122 are arranged alongside one another, as can be seen from Fig. 30, and provided with respective pneumatic cylinders 124.

[0081] The nut elements 130 coming from the sorting device 70 (not shown in Fig. 29) are filled into a guide passage 126 matched to the nut elements and slide to the right under gravity (see Fig. 29). A detector 128 checks whether sufficient nuts are provided in the guide channel 126. If no nuts can be found here, then this is an indication that the supply of nuts has come to an end, which leads via the control in the control cabinet to the supply system and also to the user being switched off, or at least a warning is given to the operator, for example via an indicator 38, or as an acoustic signal or as a blinking signal, that the supply needs to be topped up.

[0082] In order to be able to transport the nut elements 130 on further into the line 14 and to the user, a pivotally arranged finger 132 engages into the bore of a nut element 130. The finger 132 is pivotally mounted in a carriage 134 about the axis 136. The carriage is pushed to the right by the piston rod 138 of the pneumatic cylinder 124, and indeed over a stroke

which includes a plurality of elements, and is limited by the abutments 140 and 142. The cylinder 124 and the pneumatic supply 96 determine the pressure which the pivotable finger 132 exerts onto the nut elements under the control of the control cabinet 38. The line 14 is full with such nut elements. They are taken over one at a time by the setting head 20 or 20" in the press, whereby the finger 132 is advanced through a path length, which corresponds to the maximum diameter of the element. If the carriage reaches the abutment 142, then this is, for example, sensed by a pressure increase and leads to a changeover of the pneumatic cylinder 124, whereby the finger element 132 rotates about the axis of rotation 136 opposite to the force of the spring 144. The carriage 134 can then be retracted up to the abutment 140, whereby the pneumatic cylinder is changed over once again. As a result of the action of the spring, the tip of the finger element 132 engages into the bore of a nut element anew, and further nut elements are shifted to the right. The two tracks 120, 122 arranged alongside one another operate fully independent of one another.

[0083] The transport device 72" for the blowing transport is shown in Figs. 31 to 34 and is normally used with bolt elements 150.

[0084] As is evident in Fig. 31, the bolt element 150 arrive in the direction of the arrow 151 from the corresponding sorting device 70" in the desired transport position and are correspondingly guided by a guide channel 152. In the blowing head 154 of the transport device there is only space for one bolt element 150. That is to say the working head 154 is matched to the dimension of the bolt elements 150. When the front bolt element 150 has reached the position of Fig. 31, which is determined by the detector 153, then the sleeve 156, which is displaceably provided in the blowing head 154 is raised by pneumatic

pressure, so that the shaft part of the bolt element 150 comes to lie in the sleeve. In the uppermost position of the displaceable sleeve 156, which is shown in the Figs. 32 and 33, a guide needle 158 leaves the sleeve 156, whereby a through-flow passage 160 opens. The air pressure prevailing in the pressure chamber 162 can now flow into the sleeve 156 and blows, as in an airgun, the bolt element in the direction of the arrow 164 into the attached line 14.

[0085] A sensor 128 also serves here for the determination of whether sufficient bolt elements 150 are provided. In this embodiment a pivotally arranged finger 164 projects under the action of the spring 168 into the upper part of the blowing head 154 and prevents the blowing of a bolt element if a line 14 is not present. On inserting the end of the line 170, the finger 164 is pivoted against the force of a spring by the pin 172 out of the bore 174. A spring-loaded index pin 176 engages into a groove at the end 170 of the line and latches in this manner the connection between the blowing head 154 and the line end 154.

For the insert of the line end 170 and for the release of the connection, it is necessary to draw the head 178 of the index pin outwardly.

[0086] Finally, Fig. 35 shows an alternative transport unit, which is here designed as a magnetic transport device.

[0087] The elements which are here likewise shown as nut elements come from the associated sorting units 70 or 70' via the correspondingly designed guide channel 180 into the lower peripheral region of a rotating magnetic wheel 182, which attracts the nut elements and moves them along in the direction of rotation 184 of the magnet wheel 182 until they reach a deflector 186. At the deflector the nut elements enter into a further guide

passage 188 and from there into a line 14 leading to the user. That is to say, the nut elements 130 are transported further in the arrow direction 190 and in the line 14. The device 192 represents a quick connection coupling for the line 14.

[0088] As mentioned earlier, the sorting devices and the transport devices of the present invention will typically be formed as units, i.e., modules, which can be connected together in any desired number and/or design to form the exchangeable module. As also described, the exchangeable module will be connected pneumatically and electrically to the basic module via multi-plugs 60 and 62. It is advantageous if the individual sorting and transport units are equipped with pneumatic lines and electrical leads, which can themselves be connected to the sockets for the multi-plugs 60 and 62 via respective quick connections.

This facilitates the rapid assembly of an exchangeable module from a plurality of sorting and transport units. If the basic module end of the multi-plug connector is a socket rather than a plug, then the plug will be provided on the exchangeable module and the individual pneumatic and electrical leads will be connected to respective "pins" of the plug on the exchangeable module 42 via respective quick couplings. The multi-plugs 60 and 62 have a sufficient number of individual connection locations, i.e., "pins", that they can supply the required number of hydraulic and electrical lines for the maximum number of sorting and transport units which can be used with the basic module.

[0089] Since each "pin" of the pneumatic multi-plug 60 is connected to a respective pneumatic line of one of the associated sorting and transport units, the electronic programming of the control cabinet can be such that the appropriate pressure is applied to

each respective pin, and thus to the associate lad, via the associated solenoid operated pressure control valve.